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(54) Semiconductor device having aluminum contacts or vias and method of manufacture therefor

(57) A semiconductor device and a method of manufacture therefor. The semiconductor device includes: (1) a substrate having a recess therein, (2) an aluminum-alloy layer located over at least a portion of the substrate and filling at least a portion of the recess and (3) a protective metal layer at least partially diffused in the aluminum-alloy layer, the metal protective layer having a high affinity for oxygen and acting as a sacrificial target for oxygen during a reflow of the aluminum-alloy layer.

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sacrificial target for oxygen during a reflow of the conductive layer to reduce oxidation in the conductiv layer.

The present invention thereby introduces the broad concept of reducing the oxidation that occurs in the conductive layer by providing a barri r or cap, in th form of the oxidized metal, that traps oxygen before it reaches the conductive layer or removes it from the conductive layer in the event that the conductive layer partially oxidizes prior to deposition of the protective oxidizable metal layer. The present invention therefore allows a conductive plug to be formed reliably without requiring the exotic low pressure environment of the prior art.

The foregoing has outlined, rather broadly, preferred and alternative features of the present invention so that those skilled in the art may better understand the detailed description of the invention that follows. Additional features of the invention will be described hereinafter that form the subject of the claims of the invention. Those skilled in the art should appreciate that they can readily use the disclosed conception and specific embodiment as a basis for designing or modifying other structures for carrying out the same purposes of the present invention. Those skilled in the art should also realize that such equivalent constructions do not depart from the spirit and scope of the invention in its broadest form.

Claims

1. A semiconductor device, comprising: a substrate having a recess therein;

   a conductive layer located over at least a portion of said substrate and filling at least a portion of said recess to form a plug within said recess, said conductive layer susceptible to oxidation; and
   a metal protective layer at least partially diffused in said conductive layer, said metal protective layer having a high affinity for oxygen and acting as a sacrificial target for oxygen during a reflow of said conductive layer.

2. A method of manufacturing a semiconductor device, comprising the steps of:

   depositing a conductive layer over at least a portion of a substrate, said conductive layer filling at least a portion of a recess located in said substrate, said conductive layer susceptible to oxidation;
   depositing a metal protective layer over said conductive layer, said metal having a high affinity for oxygen; and
   reflowing said conductive layer, said metal protective layer oxidizing and at least partially diffusing into said conductive layer, said metal protectiv layer acting as a sacrificial target for oxygen during said reflowing.

3. The device of claim 1, or the method of claim 2, wherein said substrate comprises silicon.

4. The device of claim 1, or the method of claim 2, wherein said metal protective layer decreases the rate of electromigration damage accumulation in said conductive layer.

5. The device of claim 1, or the method of claim 2, wherein said metal is selected from the group consisting of: titanium, vanadium, magnesium, yttrium, hafnium, cerium. scandium, and zirconium, and is alloyed with an aluminum alloy.

6. The device or method of claim 5, wherein said metal is selected from titanium and vanadium, or from magnesium, yttrium, hafnium, cerium, scandium, and zirconium.

7. The device of claim 1, wherein said metal protective layer is fully diffused in said conductive layer, or the method of claim 2, wherein said step of reflowing comprises the step of fully diffusing said metal protective layer in said conductive layer.

8. The device of claim 1, or the method of claim 2, wherein said conductive layer is an aluminum-alloy layer.

9. The device of claim 1, or the method of claim 2, wherein said conductive layer fills at least said portion of said recess and forms a contact for said semiconductor device.